

Development of an IVE/EVA Compatible Prototype Cold-Gas Cubesat Propulsion System at NASA/JSC

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Cold-gas propulsion systems are well suited for some applications because they are simple to design and build, have low operating costs, and are non-toxic. The inherent tradeoff, however, is their relatively low impulse density. Nevertheless, a modest propulsion system, sized for Cubesats and designed for affordability, presents an attractive system solution for some missions, such as an on-orbit inspection free-flyer. NASA has a long-standing effort to develop propulsion systems appropriate for very high delta-V cubesat missions, such as geo transfer orbits, and there are commercially available Cubesat propulsion systems with considerably more impulse capability, but, these are both prohibitively expensive for some development customers and face compatibility constraints for crewed applications, such as operation within ISS.

A relatively conventional cold-gas system has been developed at NASA/JSC taking advantage of existing miniature industrial components, additive manufacturing techniques and in-house qualification of the system. The result is a nearly modular system with a 1U form factor. Compressed nitrogen is stored in a small high-pressure tank, then regulated and distributed to 12 thrusters. Maneuvering thrust can be adjusted, with a typical value of 40 mN, and the delta-V delivered to a 3U Cubesat would be approximately 7 m/s. These values correspond to the performance parameters for an inspection mission previously established at JSC for inspection of the orbiter prior to reentry. Environmental testing was performed to meet ISS launch and workmanship standards, along with the expected thermal environment for an inspection mission. Functionality has been demonstrated, and performance in both vacuum and relevant blowdown scenarios was completed. Several avenues for further improvement are also explored. Details of the system, components, integration, tests, and test data are presented in this paper.